

## CLAIMS

1. A vacuum seal (20; 120) for sealing a pair of opposed metal flanges (110A, 100B), the seal (20; 120) comprising an outer metallic annular member (24; 124) having a generally c-shaped longitudinal radial cross-section and an inner metallic annular member (22; 122) having a generally c-shaped longitudinal radial cross-section, wherein the outer metallic annular member (24; 124) has a pair of oppositely-directed, longitudinally outward-projecting, ridges (40A,40B) for deformably engaging the pair of opposed metal flanges (100A,100B) and the inner metallic annular member has longitudinal strength and elasticity effective to maintain the ridges (40A,40B) in engagement with the flanges.

2. The seal of claim 1 wherein the inner metallic annular member (22; 122) provides the primary structural integrity of the seal.

3. The seal of claim 1 wherein the inner metallic annular member (22; 122) has a characteristic thickness of between about 2 and 4 times a characteristic thickness of the outer metallic annular member (24; 124).

4. The seal of any of claims 1-3 wherein the inner metallic annular member (22; 122) is formed of a nickel-based superalloy and the outer metallic annular member (24; 124) is formed of an aluminum-based material.

5. The seal of any of claims 1-3 wherein the each of the ridges has a longitudinal extent ( $L_3$ ) beyond a thickness of the outer member away from the ridges.

6. An annular vacuum seal (20; 120) for sealing first and second opposed flanges (100A,100B) to maintain an internal pressure less than an external pressure, the seal (20) having nested inner (22; 122) and outer (24; 124) members and having a longitudinal radial section which is characterized by:

the outer member (24; 124) being generally c-shaped and open radially outward; and

the inner member (22; 122) nested within the outer member (24) and being generally

c-shaped and open radially outward and having a wall thickness effective to maintain the outer



member in engagement with the first and second flanges in the absence of a spring nested within the inner member.

7. The seal of claim 6 wherein:

5 the inner member (22; 122) has a full plating of a copper-base material.

8. The seal of claim 6 wherein:

the inner member (22; 122) is formed of a nickel-base superalloy; and  
the outer member (24; 124) is formed of an aluminum-base material.

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9. The seal of any of claims 6-8 being effective to provide a leakage rate of no more than about  $4 \times 10^{-12}$  cm<sup>3</sup>/s-mm.

10. The seal of any of claims 1-3, 6-8 wherein the inner metallic annular member (122) longitudinal radial cross-section has a central arcuate portion (150) and a pair of distal straight portions (150A, 150B) extending radially outward from opposite ends of the arcuate portion.

11. A method for manufacturing an annular vacuum seal (20; 120) for sealing first and second opposed flanges (100A, 100B) to maintain an internal pressure less than an external pressure, the seal having nested inner (22; 122) and outer (24; 124) members:

welding ends of a piece of a first metal together to form a first band;

die-forming the first band into a generally c-shaped, open radially outward,

cross-section so as to form the inner member (22; 122) having a wall thickness effective to resist compression of the seal between the first (100A) and second (100B) flanges so as to

25 maintain the outer member (24; 124) in sealed engagement with the first (100A) and second (100B) flanges to maintain said internal pressure;

inserting a second band of a second metal within the first band;

forming the second band into a c-shaped cross-section around the inner member (22; 122); and

30 roll-forming first and second opposed, longitudinally outward projecting, annular ridges in the second band to provide the outer member (24; 124).

12. The method of claim 11 wherein:



the inner member is plated prior to insertion of the second band; and  
the ridges are flat lapped.

13. An annular vacuum seal (20; 120) for sealing first and second opposed flanges  
5 (100A,100B) to maintain an internal pressure less than an external pressure, the seal (20)  
having nested inner (22; 122) and outer (24; 124) members and having a longitudinal radial  
section which is consists essentially of:

the outer member (24; 124) being generally c-shaped and open radially outward;

- 10 the inner member (22; 122) nested within the outer member (24) and being generally  
c-shaped and open radially outward and having a wall thickness effective to maintain the outer  
member in engagement with the first and second flanges; and  
optionally one or more coating or plating layers.

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